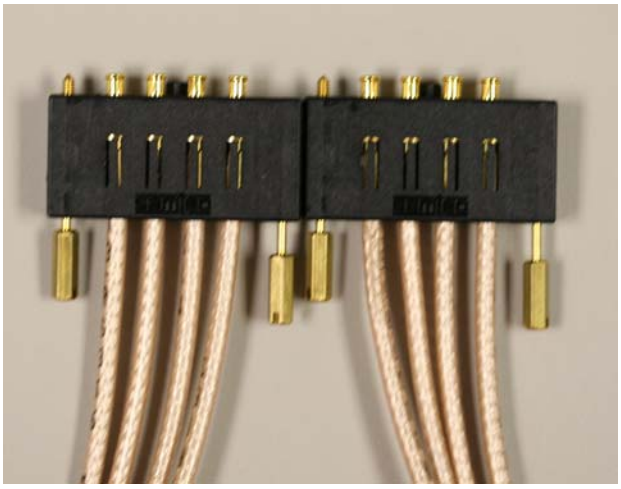
High Data Rate Characterization Report

GRF1-P-C-04-1000-C1-D-S



Mated with:
GRF1-J-P-04-X-ST-TH1 and GRF1-J-P-04-X-ST-TH1

Description:
Ganged Micro-Mini RF Cable Assembly

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Series: GRF1-C
Description: Ganged Micro-Mini RF Cable Assembly

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Introduction

This testing was performed to evaluate the electrical performance of the GRF1-C series of high-speed cable systems. Testing was performed in accordance to the High Performance Electrical Interconnect (HPEI) SFF-8416, Level 1[1] testing standards when applicable.

Time domain and frequency domain measurements were made. Time domain measurements included impedance, propagation delay, crosstalk and skew. Frequency domain measurements were preformed using Tektronix's IConnect® and Measurement XTractor™ software (Version 3.6.0) and included insertion loss (IL), return loss (RL), standing wave ratio (SWR), near end crosstalk (NEXT) and far end crosstalk (FEXT). All measurements were made utilizing test boards specifically designed for this project and are referred to as "test board" in this report. The test boards were identified as "PCB-100838-TST-XX".

Product Description

The test sample consists of four (4) 1-meter long CCA-316 coaxial cables. At both ends of the assembly each coaxial cable terminates to an RFXXX-13GP1-SING-XXXX plug which is part of a ganged assembly having the plugs mounted in a plastic housing with captive panel screws and a polarization key.

The GRF1-C cable assembly was tested by mating it at each end to a GRF1-J-P-04-X-ST-TH1 Ganged RF Jack Connector. One sample was tested. The actual part number that was tested is shown in Table 1, which also identifies End 1 and End 2 of the assembly; a relative sample picture is shown in Figure 1. Two lines, an inner line and an outer line, of the sample were tested.

Length	Part Number	End 1	End 2
1000 mm	GRF1-P-C-04-1000-C1-D-S	GRF1-P	GRF1-P

Table 1: Sample Description

Ends 1 and 2 are identical. Hence, one end was selected and designated "End 1" and marked with a white dot on the plastic housing.

[1] Measurement and Performance Requirements for HPEI Bulk Cable, Rev 15, June 27, 2005

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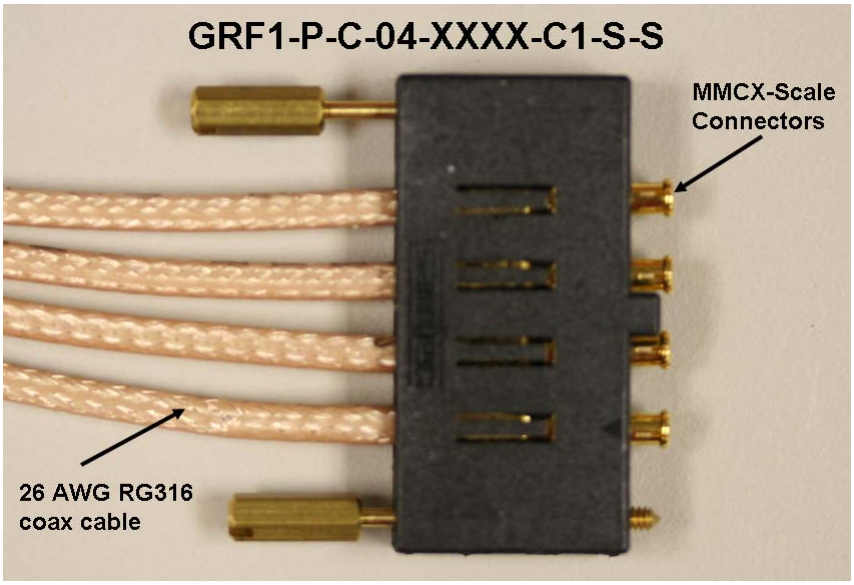

Figure 1: GRF1-C Termination

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Description: Ganged Micro-Mini RF Cable Assembly

Results Summary

Time Domain Data

Impedance

Impedance measurements were performed using a filtered risetime of 100 pS.
Note that all measurements were performed with the cable assembly mated to the respective connector/test board. Data was measured at the cable connector and 200 pS into the cable.

Assembly	Path	End Option End 1		Cable End 1
		Z_{Min} (Ω)	Z_{Max} (Ω)	Z_{Nom} (Ω)
GRF1-P-C-04-1000-C1-D-S	Outer	44.2	51.6	49.8
	Inner	44.4	51.8	50.2

Table 2: Impedance Measurements

Timing Measurements

Skew was calculated as the difference between the propagation delay of the longest and the shortest electrical paths. End 1 of the assembly was the source end for these measurements.

The results are tabulated below.

Assembly	Path	Propagation Delay (nS)	Skew (nS)
GRF1-P-C-04-1000-C1-D-S	Outer	4.796	.007
	Inner	4.789	

Table 3: Timing Measurements

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NEXT

The near end crosstalk was measured in the time domain and converted to a percentage and reported below in Table 4. The incident pulse amplitude from the TDR was 235 mV. The acquired data was measured using a filtered rise time of 100 pS. The End 1 heading in Table 4 represents the near-end cable assembly connector, i.e. the source end. All NEXT measurements were performed with the cable assembly mated to the respective connector/test board. Since most of the crosstalk occurs in the connectors, the values in Table 4 represent the crosstalk that occurs in the near-end mated cable assembly and the test board connectors.

Assembly	Path	End 1	
		NEXT (mV)	NEXT (%)
GRF1-P-C-04-1000-C1-D-S	Outer	0.12	0.05
	Inner	0.16	0.07

Table 4: % NEXT

FEXT

The far end crosstalk was measured in the time domain and converted to a percentage and reported below in Table 5. The incident pulse amplitude from the TDR was 235 mV. The acquired data was measured using a filtered rise time of 100 pS. The End 1 heading in Table 5 represents the near-end cable assembly connector, i.e. the source end. All FEXT measurements were performed with the cable assembly mated to the respective connector/test board. The values in Table 5 represent the crosstalk measured at the far end of the assembly.

Assembly	Path	End 1	
		FEXT (mV)	FEXT (%)
GRF1-P-C-04-1000-C1-D-S	Outer	0.16	0.07
	Inner	0.22	0.09

Table 5: % FEXT

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Frequency Domain Data

Insertion Loss

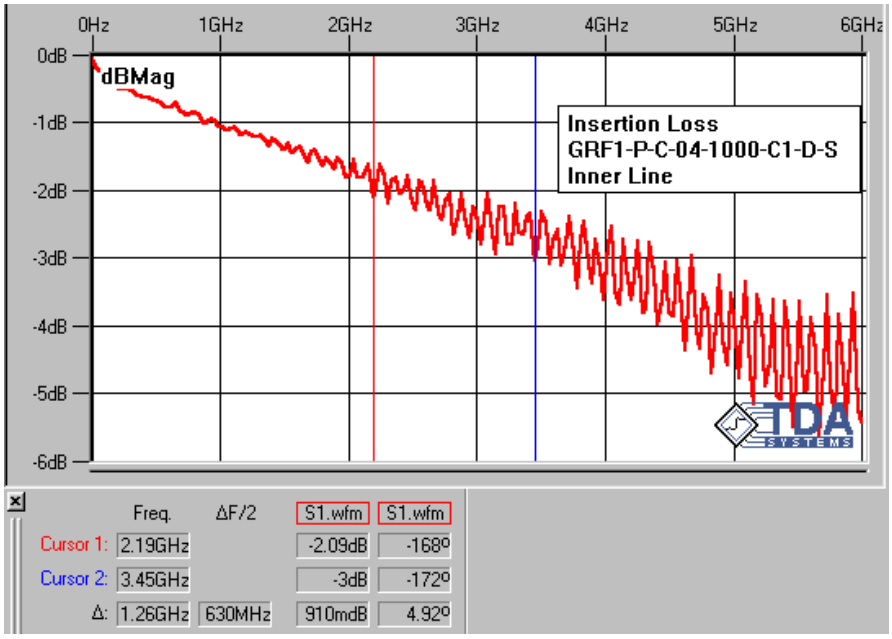

Figure 2: GRF1-P-C-04-1000-C1-D-S Insertion Loss Inner Path

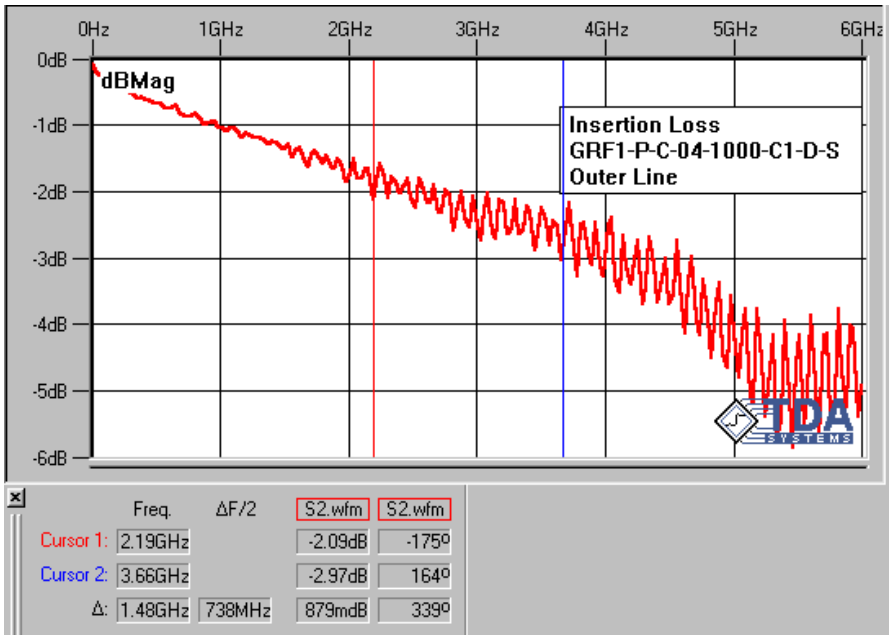

Figure 3: GRF1-P-C-04-1000-C1-D-S Insertion Loss Outer Path

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Return Loss

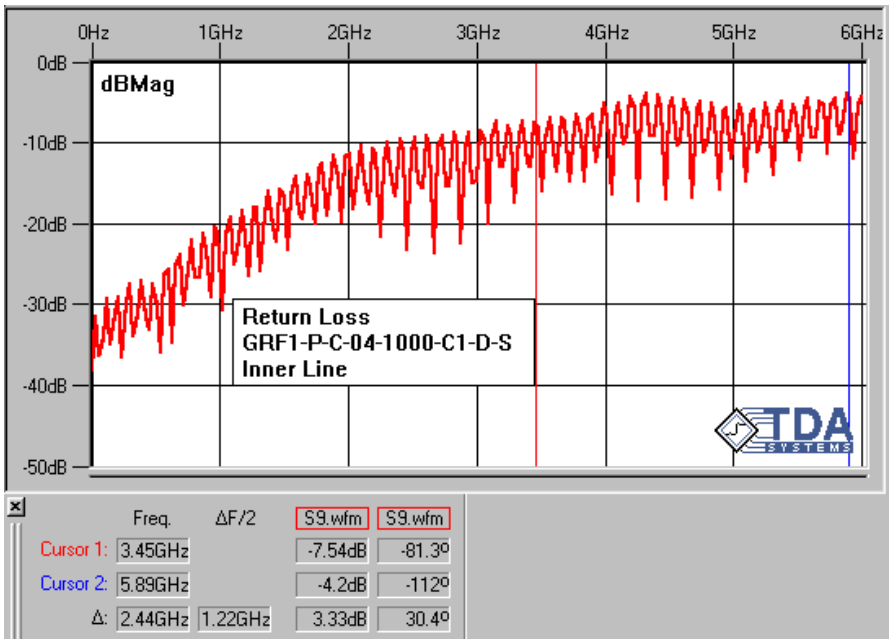

Figure 4: GRF1-P-C-04-1000-C1-D-S Return Loss Inner Path

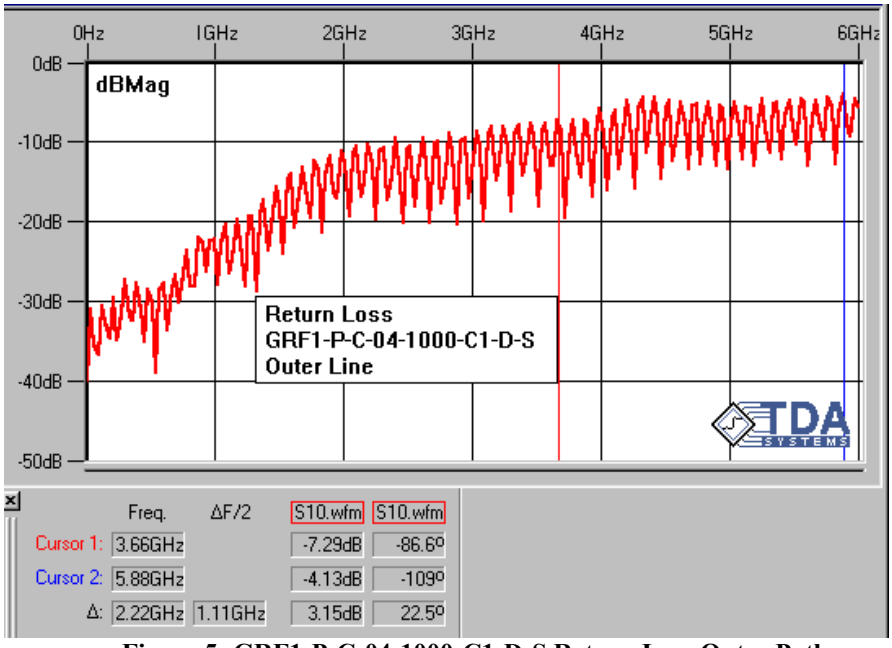

Figure 5: GRF1-P-C-04-1000-C1-D-S Return Loss Outer Path

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SWR

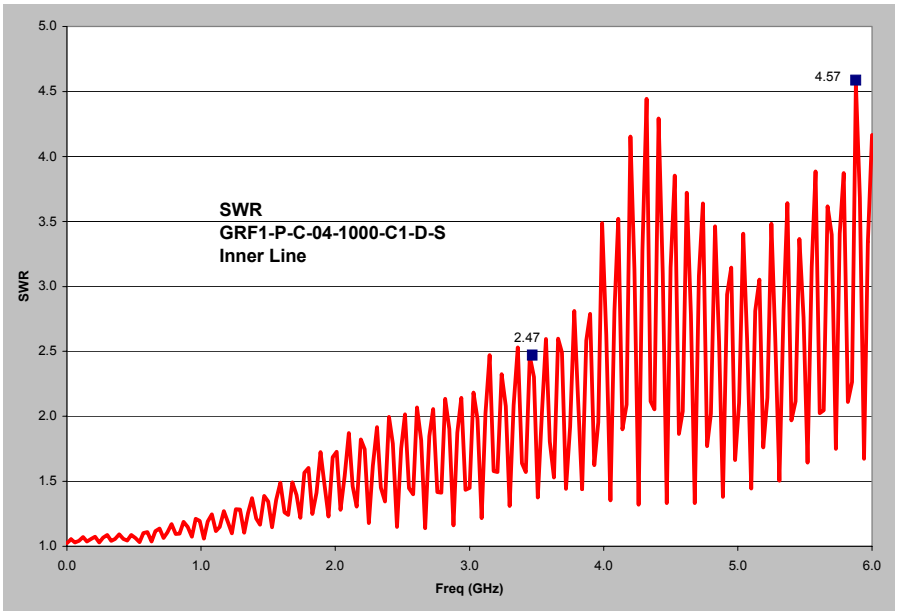

Figure 6: GRF1-P-C-04-1000-C1-D-S SWR Inner Path

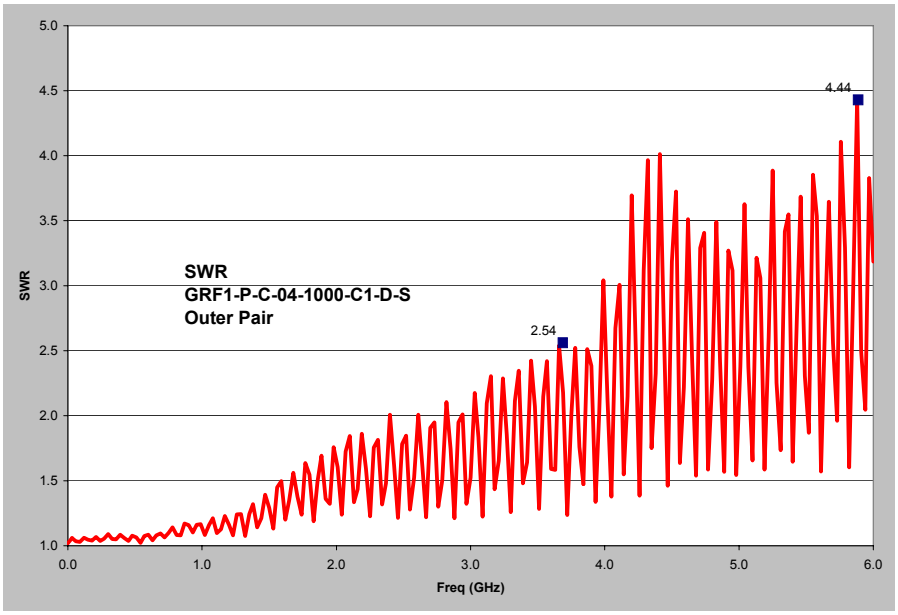

Figure 7: GRF1-P-C-04-1000-C1-D-S SWR Outer Path

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Near End Crosstalk

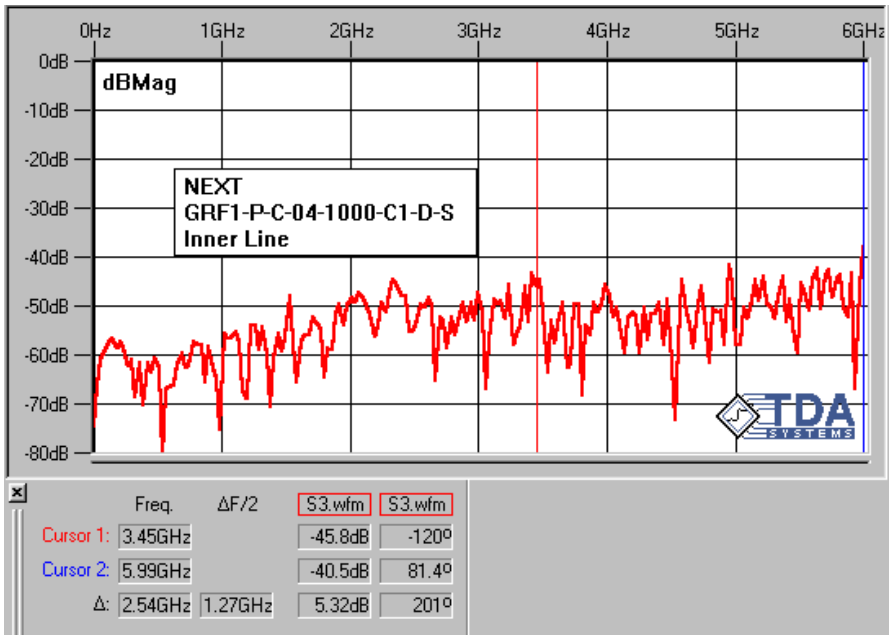

Figure 8: GRF1-P-C-04-1000-C1-D-S NEXT Inner Path

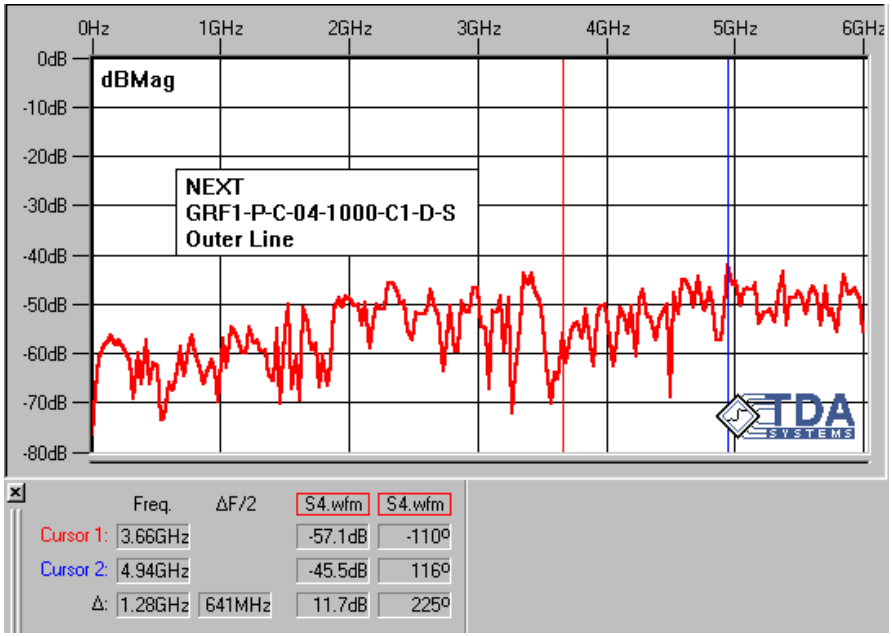

Figure 9: GRF1-P-C-04-1000-C1-D-S NEXT Outer Path

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Far End Crosstalk

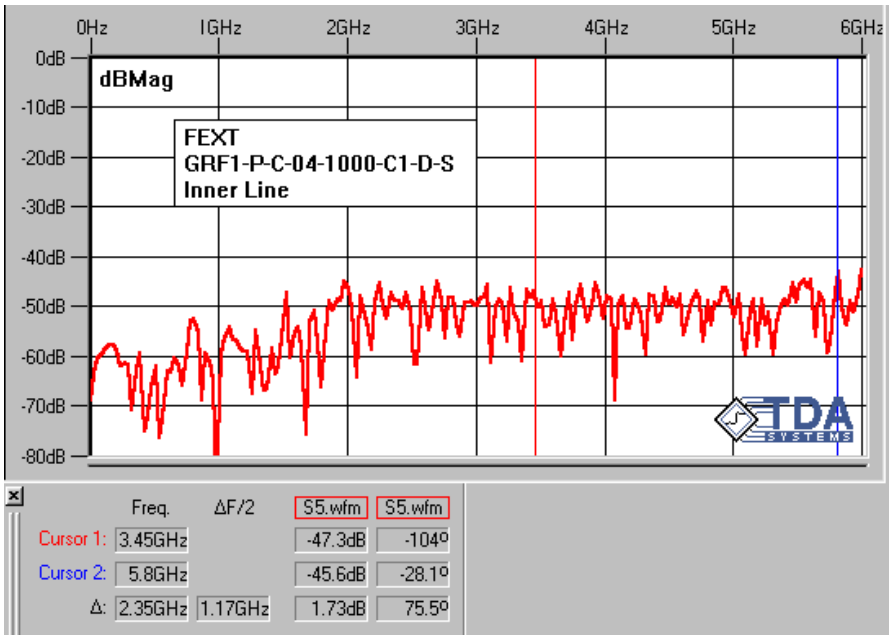

Figure 10: GRF1-P-C-04-1000-C1-D-S FEXT Inner Path

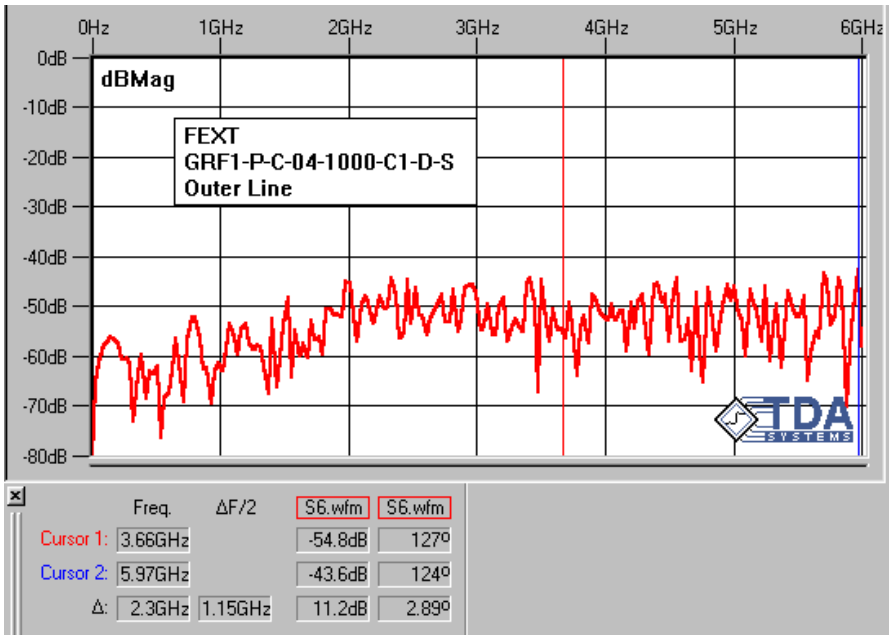

Figure 11: GRF1-P-C-04-1000-C1-D-S FEXT Outer Path

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Test Procedures

Fixturing:

All measurements were performed using the test boards. The test boards have trace lengths of 1.00 inches and provide for the interconnection to the GRF1-C cable by use of replaceable SMA connectors. The PCB-100838-TST-XX test board has a THRU reference trace. Figure 12 below shows how the THRU reference trace was utilized to compensate for the losses due to the coaxial test cables, SMA launches, and the test board traces during testing.

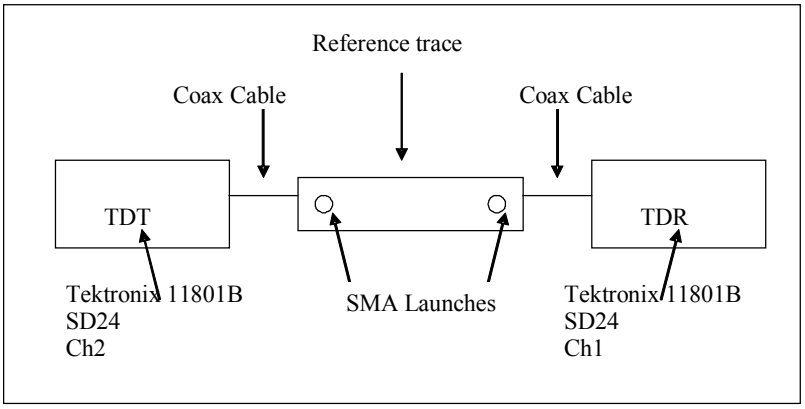

Figure 12: Test setup for Thru Reference Acquisition

Measurements were then performed using the test boards as shown in Figure 13. A picture of the test board and cable is shown in Figure 14.

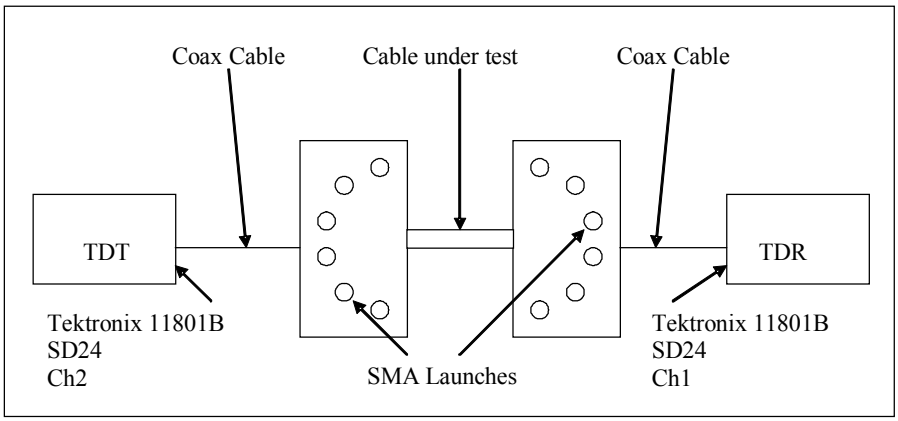

Figure 13: Characterization test setup

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Figure 14: Test setup with Test PCBs and GRF1-C cable.

The cable terminations had a particular Signal line configuration. The respective signal line numbers are shown in Table 6 below. There are a total of 4 positions per row. All adjacent line pairs are terminated where applicable.

	Key		
1	*2*	*3*	*4*

Table 6: Respective signal line numbers relative to polarization key.

Table 7 below shows the signal line numbers corresponding to the inner and outer paths for the different configurations tested. The test board jack numbers corresponding to the lines are listed in parentheses.

Assembly	Path	
	Inner	Outer
GRF1-P-C-04-1000-C1-D-S	Line 2 (J10)	Line 1 (J12)

Table 7: Inner Path and Outer Path Signal Line Numbers

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Time Domain Testing

Impedance:

The Tektronix 11801B oscilloscope was set up in TDR (time domain reflectometry) mode using a 100-pS filtered risetime and 16 averages. The horizontal setup of the TDR used 512 point record length and a horizontal scale of 200 pS/div to allow the near end connector and a portion of the cable to be displayed. All impedance measurements were made at the near-end connector and 200 pS into the cable.

Propagation Delay:

The propagation delay was measured and skew calculated by first acquiring a thru reference pulse of the reference trace. Using the delay function of the TDR, set at 50% amplitude of the reference pulse, the sample was inserted and the sample delay was measured. The TDR delay function calculates the sample delay by subtracting the delay measurement of the reference pulse from the delay measurement of the sample plus the test board traces.

Skew:

Skew is defined as the difference between of the propagation delays of the longest (maximum delay) and the shortest (minimum delay) electrical paths.

NEXT and FEXT:

Near end crosstalk (NEXT) and far end crosstalk (FEXT) measurements were made using the Tektronix 11801B oscilloscope. A thru reference of the coaxial test cables, SMAs, and reference board was performed to determine the pulse amplitude of the TDR generator (see Figure 12).

To acquire NEXT, a signal was applied using the oscilloscope pulse generator. NEXT was measured on an adjacent signal line at the near end (see Figure 15). To acquire FEXT, a trace was driven with the oscilloscope pulse generator. FEXT was measured on an adjacent trace at the far end (see Figure 16). All adjacent lines were terminated, at both ends, with 50Ω SMA loads; refer to Figures 15 and 16.

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Frequency Domain Testing

All frequency domain measurements were made using the Tektronix 11801B oscilloscope. Testing was performed using a risetime of 35 pS. The horizontal scale was set to 5 nS/div, the record length was set to 5120 points and the number of averages was set to 128. These values were selected to ensure the ratio between the number of points and the window length was long enough to capture the highest frequencies and still yield a small enough frequency step to gain adequate resolution. End 1 of the assembly was the source end for all frequency domain measurements. All adjacent lines were terminated at both ends with 50Ω SMA loads; refer to Figures 15 and 16.

Attenuation:
Insertion Loss test setup losses were compensated for by acquiring a thru measurement (reference output pulse) of the coaxial test cables, SMAs, and the reference trace (see Figure 12 on page 15). A thru measurement of an assembly was taken and then post processed by using Tektronix IConnect® software. The result is the insertion loss of the cable assembly.

Return Loss:
An open circuit reference measurement was taken using a signal trace on a test fixture board without mating connector to the cable assembly. A matched reflection waveform of the cable assembly, i.e. with the cable assembly terminated in 50-Ω SMA load on the far end test board, was acquired and then post processed by using Tektronix IConnect® software. The result is the return loss of the cable assembly.

Near and Far End Crosstalk:
NEXT and FEXT were measured in the time domain using the oscilloscope and then converted to frequency domain data using Tektronix IConnect® software. Initially a thru reference measurement of the coaxial test cables, SMAs, and reference board trace was performed to compensate for the test setup losses (see Figure 12).

To acquire NEXT a trace was driven using the oscilloscope pulse generator. NEXT was measured, in the time domain, on an adjacent trace (see Figure 15). NEXT was then post processed using Tektronix's IConnect® software to generate the NEXT of the cable assembly in the frequency domain.

To acquire FEXT a trace was driven using the oscilloscope pulse generator. FEXT was measured in the time domain on an adjacent trace at the far end (see Figure 16). FEXT was then post processed using Tektronix's IConnect® software to generate the FEXT of the cable assembly in the frequency domain.

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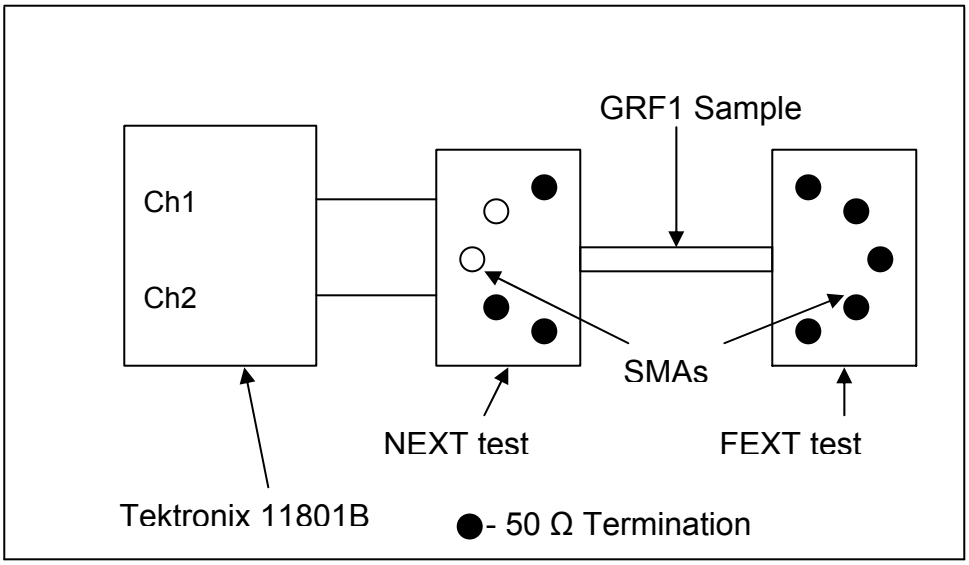

Figure 15: NEXT Measurement Setup.

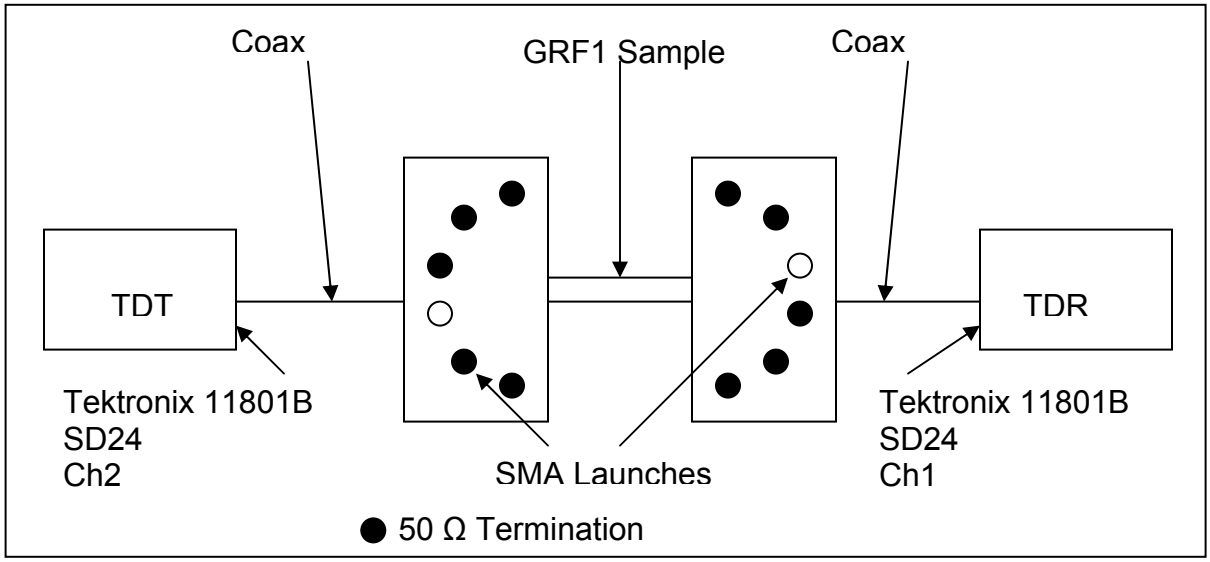

Figure 16: FEXT Measurement Setup

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Equipment

Time Domain Testing

Tektronix 11801B Oscilloscope
Tektronix SD24 TDR/Sampling Head